Title: Growing Patterns

Brief Overview:

> This unit involves building, describing, and expressing repeat addition patterns and rectangular arrays to represent multiplication tables. Students will use the constant calculator function to construct a visual representation of the multiplication tables. Students will apply their knowledge of multiplication arrays by constructing a giant classroom array.

Links to NCTM Standards:

- **Mathematics as Problem Solving**
  Students will be able to recognize, describe, extend, and create a wide variety of arrays and patterns.

- **Mathematics as Communication**
  Students will be able to represent, explain, and describe mathematical relationships in verbal and written formats.

- **Mathematics as Reasoning**
  Students will be able to justify new patterns based on their predictions.

- **Mathematical Connections**
  Students will be able to recognize multiplication arrays using patterns and real-world examples.

- **Concepts of Whole Number Operations**
  Students will be able to construct multiplication arrays.

- **Whole Number Computation**
  Students will be able to write equations to represent multiplication arrays and patterns.

- **Geometry and Spatial Sense**
  Students will construct patterns of repeat addition with geometric shapes and record their data by creating charts and tables.

- **Patterns and Relationships**
  Students will investigate relationships within real-world contexts, concrete models, and abstract reasoning activities.

Grade/Level:

> Grades 3-4

Duration/Length:

Three class periods (variable)

Prerequisite Knowledge:

Students should have working knowledge of the following:

- Repeat addition
- Basic operation of a calculator
- Skip counting

Objectives:

Students will:

- create and explain a growing pattern.
- recognize, describe, and extend patterns.
- use constant function on the calculator to build multiplication fact charts.
- construct a function table.
- model multiplication arrays using concrete and abstract materials.
- explain reasoning and strategy using written and pictorial formats.
- construct multiplication arrays matching a given product.

Materials/Resources:

Teacher:
- Chart paper, ½" graph paper, math talk chart, overhead, roll of 1" square grid paper, black line masters, overheads of directions for each day

Student:
- Markers, crayons, ruler, glue, square tiles, pencil, scissors, calculator, math journal, pattern masters, ½" graph paper

Development/Procedures:

Day One: Real-World Function Tables

Teacher introduces multiplication by asking students to respond to the following question in their journals: "What is multiplication?" Teacher selects three to four students to share their responses. Teacher then tells students they will begin the study of multiplication by exploring the relationship between real-world objects, people, patterns, and multiplication.

Teacher presents the following vignette to students:

Imagine that you want to go roller-skating. How many skates do you need? As you are walking to the roller rink you meet a friend and ask him/her to come along. Now how many skates do you need? By the time you arrive at the roller rink there are three of you who need skates. How many skates will you need?

After students respond verbally, introduce the concept of a function table, adding this vocabulary term to the math talk chart displayed in the classroom (See teacher Resource Sheet 1.0). Display a partially completed function chart to students: (X's represent people, 0's represent skates.)

Function Table

Skaters	X	XX	XXX	XXXX		
Skates	OO	OO OO	OO OO OO	OO OO OO OO		
Number of Skaters	1	2	3	4		
Number of Skates	2	4	6	8		

The teacher will then pose the following vignette to the class.
Vignette:
Our class had a picnic at Hyde Park. While we listened to our teacher read the story, 100 Hungry Ants by Elinor J. Pinczes, those pesky ants carried off our goodies. Instead of marching off one by one—Hurrah—Hurray!—they formed rows of sixes. This enabled them to carry away an entire cake and our watermelon.

The teacher sketches ants in rows of sixes on chart paper. (One group of six carries off a cake—two groups of six carry off the watermelon) Ask students to imagine what three groups of six ants could carry away, adding their response to the previous sketch; continue with four groups of six ants carrying away an ever-larger object. (Science Connection: Ants can carry ten times their weight.)
Frame a discussion that emphasizes growing patterns, highlighting the growing object and the increase in rows of ants. Add new vocabulary terms to the Math Talk Chart.

Next, students are instructed to read the following directions displayed on the overhead and complete the activity. (See Teacher Resource, Page 1.1)

Directions

1. **You and your math buddy need one piece of construction paper and a black marker or crayon.**

2. **Build the four models you see on the "Hungry Ants" Chart.**

3. **Complete the "Hungry Ants" Chart through 9 rows of 6 ants each. You may use X's or O's to represent ants.**

4. **Discuss your findings with your math buddy.**

5. **Summarize your findings in your math journal.**

Teacher circulates throughout the room encouraging students and redirecting them when needed through open-ended questioning. Teacher assesses use of math vocabulary, ability to transfer knowledge of patterns from one activity to another, use of repeat addition or number sentences to determine the total number of ants in each pattern.

Whole Group Activity:
Select several students to share their math journal entries with the class. Have students share the function tables from the "Hungry Ants" chart. Display a calculator as an efficient strategy for performing repeated addition. Distribute calculators. Teacher introduces constant calculator function by choosing +2. Teacher displays directions on sentence strip for students to read and follow.

Note: This direction is to be used with the Math Explorer Calculator.

+2—cons—0—cons—cons—cons—cons. . . .

Other calculators may use the following key sequence.

+2 = = = . . .

Students mirror teacher continuing through 2 x 4. Teacher checks student's accuracy. Students verbalize number patterns by skip counting through 2 x 10. Teacher pauses and displays an unfinished multiplication chart.

Multiplication Chart

X	1	2	3	4	5	6	7	8	9	10
2	2	4	6	8						
3										
4										
5										
6										
7										
8										
9										
10										

Using the constant function on the calculator, students are to complete the multiplication chart through 10 x 10. Teacher circulates encouraging and redirecting students as needed. Conclude lesson by skip counting and looking for patterns and relationships on the multiplication chart. Ask students what strategy they would use to continue each number pattern to the 15th place, the 20th place, the 50th place?

Day Two: Rectangular Arrays/Problem Solving

Warm-up: Teacher has made a chart that shows a 6 x 2 rectangular array with the matching multiplication problem.
Students read following directions on overhead:

Directions

1. **You and your math buddy need a sheet of 1" square graph paper and 24 squares.**

2. **Build the rectangle on the chart and copy the matching multiplication equation.**

3. **Build a second rectangle that is 6 squares wide and 2 squares long.**

4. **With your buddy discuss the following questions: How are these two rectangles the same? How are these two rectangles different?**

5. **Record your observations in your journal.**

Teacher circulates during activity encouraging and redirecting students as needed. Select several students to share their observations emphasizing that if students know what 2 x 6 is they also know 6 x 2. Direct students to take their squares and build a rectangle on the 1" square graph paper that is 6 squares wide and 4 squares long then write the matching multiplication fact. Next, direct students to build a rectangle that is 4 squares wide and 6 squares long and write the matching multiplication fact. Ask students to reflect on how this problem is like the first one they did. Guide students to conclude that changing the order of the factors does not change the product in a multiplication problem.   Focus student attention on their own multiplication chart, highlighting the products generated by the completed arrays. Ask students how their knowledge of doubles might help them predict patterns in multiplication.

Divide the class into groups of four. Use Student Resource Sheets 1.0 – 1.7 to make cards for the game. Use Teacher Resource Sheet 1.3 if you do not have square plastic tiles. Display the following set of directions for The Rectangular Array Game on the overhead.

Directions: The Rectangular Array Game

1. **The youngest person on your team will take a packet, a bag of plastic squares, and two sheets of 1" square graph paper off the materials table.**

2. **The youngest member passes out a card to each member.**

3. **Moving clockwise, starting with the youngest member, each person will read his or her clue aloud.**

4. **Follow clues to complete the activity.**

5. **Raise hand for teacher to check your solution.**

6. **Youngest member clips cards back together and trades for a new packet at materials table.**

7. **Repeat with second group of cards; continue process until time is called.**

Teacher circulates assessing student's ability to build rectangular arrays, apply order property of multiplication, make observations about emerging patterns, and use math vocabulary to explain reasoning.

Conclude lesson with the following journal entry prompt:
If 6 x 3 is 18, why can you double 18 to find out that the product of 6 x 6 is 36?
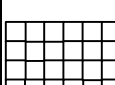
Day Three: Giant Classroom Chart of Arrays

The teacher will guide students in building a Giant Classroom Chart of Arrays using the information they have discovered about patterns, arrays, and multiplication.

Teacher Note:

The same multiplication chart is used as in Day 1 only instead of numbers, students have arrays displayed. See the example below.

Classroom Array Chart (Sample)

X	0	1	2	3	4	5	6	7 . . .
0								
1		□	□□					
2		▤	⊞		▦			
3		▤	⊞	▦	▦▦			
4		▤	⊞		▦		▦▦	
5								
6								
7								
8								
9								
10								

Extension/Follow Up:

Strategy Game of <u>How Long? How Many?</u> Page 76 in <u>Math By All Means Multiplication Grade Three </u>by Marilyn Burns, 1991.
Skip counting game for multiplication and division. <u>Skip, Skip to My Lou</u>, page 6-1, <u>Math Games for Kids Using Cards and Dice</u>, volume 1, Joanne Currah, 1989
Songs: The Ants Go Marching One by One

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MATH TALK

This is vocabulary that is introduced and used throughout the unit. Also, include other significant vocabulary that students use in a separate column.

table

relationship

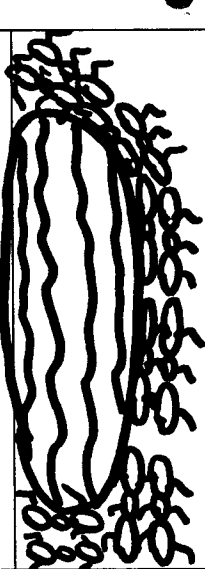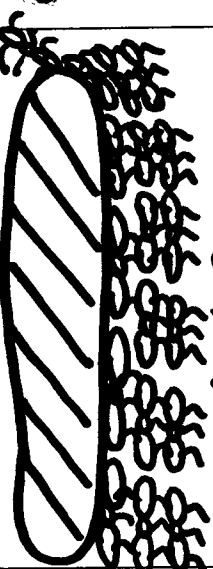pattern
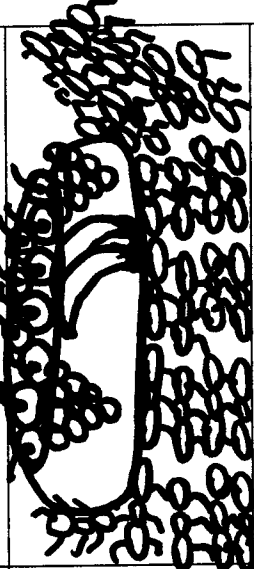
array

core

compare

contrast

function

repeat

constant

double

alike

different

Hungry Ants

Rows of Ants					
Matching Multiplication Equation	6 x 1 = 6	6 x 2 = 12	6 x 3 = 18	6 x 4 = 24	. . . .

Build 4 different
rectangles.
Each rectangle
uses 12 squares.

Build 4 different
rectangles.
Each rectangle
uses 24 squares.

Draw and color each
rectangle on 1"
square graph paper.

On the 1" square graph
paper write the match-
ing multiplication equa-
tion under each
rectangle.

Student Resource 1.0

Build 4 different
rectangles.
Each rectangle
uses 24 squares.

Build 2 different
rectangles.
Each rectangle
uses 48 squares.

Draw and color each
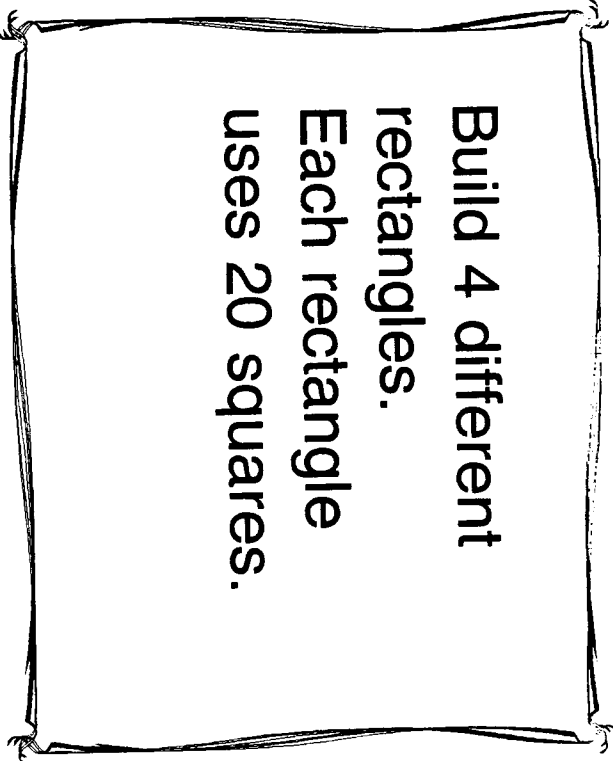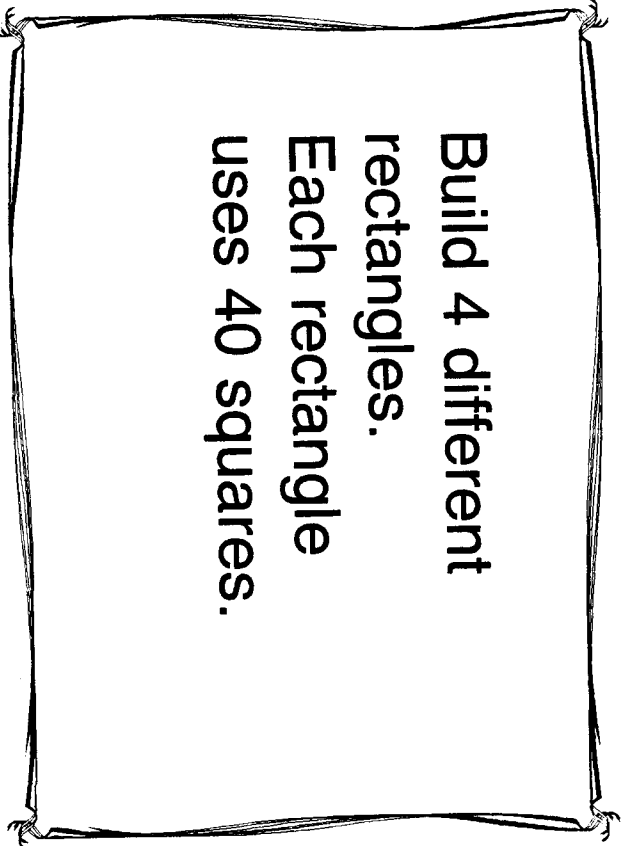rectangle on 1"
square graph paper.

On the 1" square graph
paper write the match-
ing multiplication equa-
tion under each
rectangle.

Student Resource 1.1

Build 4 different
rectangles.
Each rectangle
uses 18 squares.

Build 3 different
rectangles.
Each rectangle
uses 36 squares.

Draw and color each
rectangle on 1"
square graph paper.

On the 1" square graph
paper write the match-
ing multiplication equa-
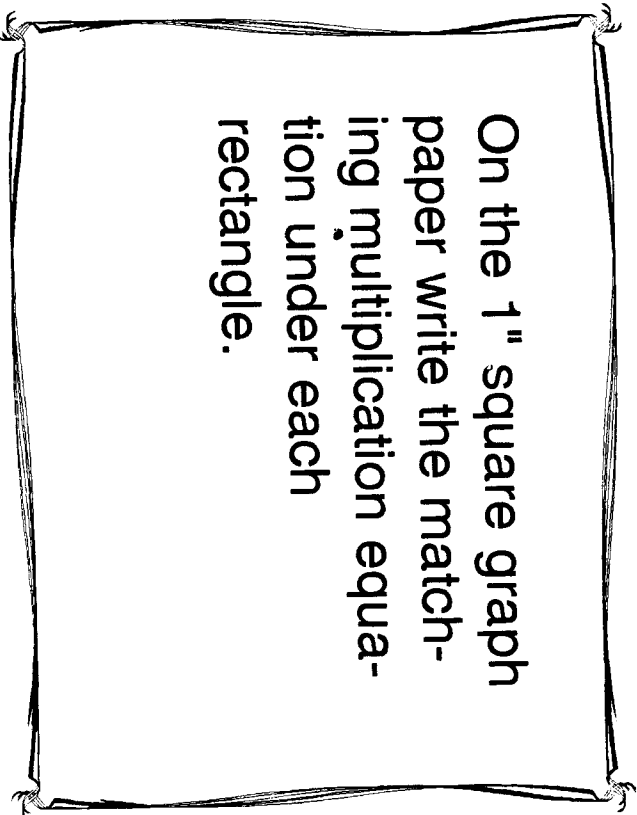tion under each
rectangle.

Student Resource 1.2

Build 4 different rectangles. Each rectangle uses 20 squares.

Build 4 different rectangles. Each rectangle uses 40 squares.

Draw and color each rectangle on 1" square graph paper.

On the 1" square graph paper write the matching multiplication equation under each rectangle.

Student Resource 1.3

Build 2 different
rectangles.
Each rectangle
uses 28 squares.

Build 2 different
rectangles.
Each rectangle
uses 56 squares.

Draw and color each
rectangle on 1"
square graph paper.

On the 1" square graph
paper write the match-
ing multiplication equa-
tion under each
rectangle.

Build 2 different rectangles.
Each rectangle uses 15 squares.

Build 4 different rectangles.
Each rectangle uses 30 squares.

Draw and color each rectangle on 1" square graph paper.

On the 1" square graph paper write the matching multiplication equation under each rectangle.

Build 2 different rectangles. Each rectangle uses 21 squares.

Build 2 different rectangles. Each rectangle uses 42 squares.

Draw and color each rectangle on 1" square graph paper.

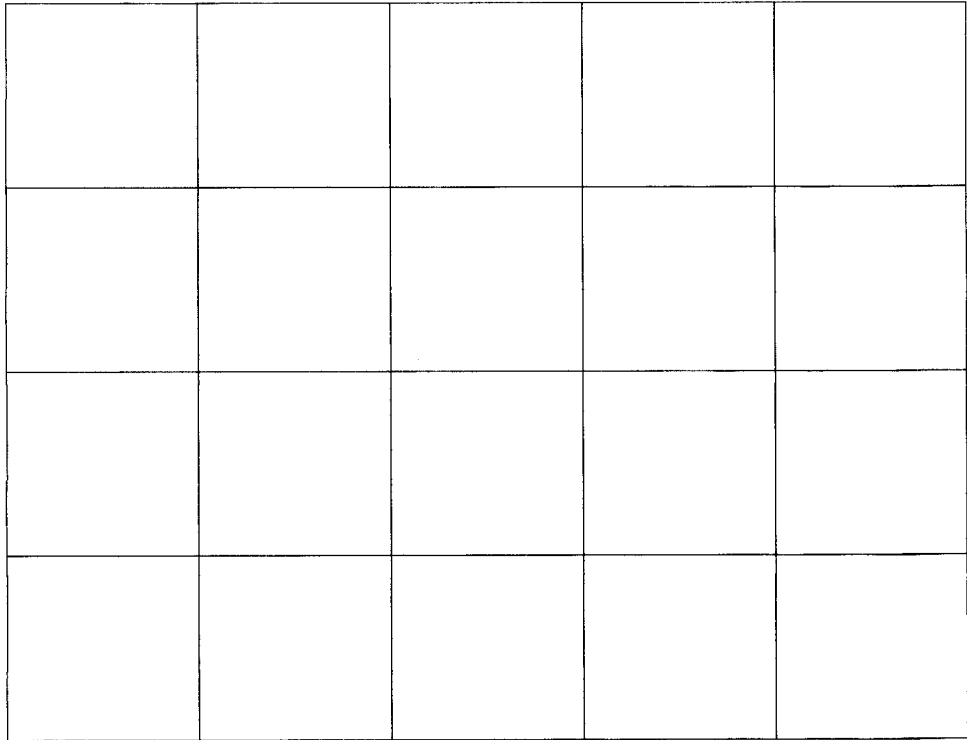On the 1" square graph paper write the matching multi-plication equation under each rectangle.

Build 3 different rectangles. Each rectangle uses 16 squares.

Build 2 different rectangles. Each rectangle uses 32 squares.

Draw and color each rectangle on 1" square graph paper.

On the 1" square graph paper write the matching multi-plication equation under each rectangle.

PAPER PATTERN BLOCK TEMPLATES

Teacher Resource 1.3